

- A. Determination of the payment adjustment of a lot of bituminous mixture will be made by successively multiplying the Contract Unit Price per Ton of the bid item by the applicable pay factors as determined in Sections 407.05 A and 407.05 B.
- B. Material for patching or leveling of an existing bituminous surface constructed under a previous Contract shall be obtained from the tonnage provided in the basis of estimate and will be paid according to the following provisions:
 - 1. If no excavation is required, payment will be made at the Contract Unit Prices for the materials used in the repair.
 - 2. When the patching requires excavation, the method and site of disposal of the waste materials shall be subject to the approval of the Engineer, and:
 - a. If the excavated material is disposed of within the Right of Way adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-1."
 - b. If the excavated material is loaded and hauled to a disposal area not adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-1."
 - c. If aggregate is required to replace excavated material in the existing base or subgrade, payment for the class of aggregate used will be made under Section 104.03 D. Payment will include disposal of excavated material, and the furnishing, placing, and compacting of the aggregate.
 - d. Payment for prime, tack, and the bitumen in the mix used in the repair will be made at the Contract Unit Prices for those items.

SECTION 408

HOT BITUMINOUS PAVEMENT

408.01 DESCRIPTION.

This work consists of constructing one or more courses of bituminous pavement on a prepared foundation.

The bituminous pavement will be a mixture of aggregate, filler if required, and bitumen.

The Contractor shall be responsible for providing an aggregate that meets the mix design properties specified.

408.02 MATERIALS.

- A. **Bitumen.** The bitumen shall meet Section 818 and will be of the type and grade specified in the Contract. Bitumen will be accepted as outlined in the Combined State Binder Group agreement for North Dakota. Samples will be obtained by the Contractor under the observation of the Engineer, and immediately handed over to the Engineer for shipping and testing.
- B. **Aggregate.** Aggregate shall meet Section 816 for the class of aggregate specified.

Acceptance will be according to Section 408.05 A.

408.03 EQUIPMENT.

Equipment shall meet the following:

Item	Section
General	151.01
Self-Propelled Pneumatic-Tired Rollers	151.02 B
Smooth-Faced Steel Wheel Rollers – Tandem – Type A	151.02 C.2
Smooth-Faced Steel Wheel Rollers – Tandem – Type B	151.02 C.3
Combination Roller	151.02 E
Vibratory Rollers	151.02 D
Material-Hauling Equipment	151.03 B
Bituminous Pavers	151.04
Scales	151.07
Hot Bituminous Equipment	152

408.04 CONSTRUCTION REQUIREMENTS.

The Contractor shall have at least one person in charge of quality control on the project at all times. This person shall be qualified as a Bituminous Mix Controller as outlined in the NDDOT Transportation Technician Qualification Program. If the Prime Contractor sublets any portion of the Contract, including aggregate production, to a Subcontractor, the Subcontractor shall have a person qualified as a Bituminous Mix Controller on the Project. If the Subcontractor does not have a qualified person, the Prime Contractor's qualified person shall be on the Project and be in charge of quality control.

- A. **Pit Operations and Stockpiling of Aggregate.** Stripping of the pit and pit operations shall be conducted according to Section 106.02.

The processed stockpiles shall be uniform and shall meet gradation requirements. Sufficient mineral aggregate shall be stockpiled at the plant site to produce at least 25,000 tons of bituminous mixture or 50% of the estimated required quantity, whichever is less, before the start of bituminous mix production. During bituminous mix production, the aggregate stockpiles shall be maintained so they contain sufficient material to produce at least 5,000 tons of bituminous mixture or 25% of the estimated required quantity to finish production at the particular plant setup, whichever is less.

- B. **Mix Design.** During production of the aggregate, the Contractor will perform gradation testing using the Department's sampling and testing procedures. The test-

ing frequency will be a minimum of one test per 1,000 tons of aggregate produced for the first 10,000 tons of aggregate. After 10,000 tons of aggregate is produced the testing frequency will be a minimum of one test per 2,000 tons of aggregate.

The Contractor will provide the Engineer with an aggregate sample representing each stockpile. The total weight of the combined sample will be about 150 pounds. This sample will be used, by the NDDOT, to develop a mix design when the plans do not specify a Contractor Mix Design. When the plans specify a Contractor Mix Design, the Contractor is still required to submit this sample. A sample tag identifying the project number, pit location, and class of aggregate shall be attached to the sample. The Contractor shall also submit in writing the average gradation of each stockpile and the proposed percentage of each stockpile to be used.

An approved mix design will be required prior to beginning plant production on all projects of hot bituminous pavement. The NDDOT will develop the mix design unless the plans specify a contractor mix design. The mix design will be developed according to the NDDOT *Field Sampling and Testing Manual*. The mix design will meet the following properties for the type of mix specified:

Mix Criteria	CLASS 27				CLASS 29				CLASS 31				CLASS 33			
	Top or wearing course		Bottom or non-wearing course		Top or wearing course		Bottom or non-wearing course		Top or wearing course		Bottom or non-wearing course		Top or wearing course		Bottom or non-wearing course	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Blows to Marshall Plug	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Stability (lbs.)	1200		1200		1500		1500		1650		1650		1800		1800	
Flow, 0.01 in.	8	18	8	18	8	18	8	18	8	16	8	16	8	16	8	16
Percent VMA ^{1,3}	14.0	16.0	14.0	16.0	14.0	16.0	14.0	16.0	14.0	16.0	14.0	16.0	14.0	16.0	14.0	16.0
Fines/Asphalt Ratio ^{2,3}	0.6	1.3	0.6	1.4	0.6	1.3	0.6	1.4	0.6	1.3	0.6	1.4	0.6	1.3	0.6	1.4
Film Thickness ³	7.5		7.5		7.5		7.5		7.5		7.5		7.5		7.5	

¹**Vooids in Mineral Aggregate (VMA).**

²The fines/asphalt ratio shall be determined by dividing the percentage of material passing the #200 sieve by the percentage of effective asphalt added to the mix. The percentage of asphalt used will be as determined in the Mix Design at 4% air voids. The effective asphalt will be determined as follows:(The formula is as defined in Manual Series No. 2 published by the Asphalt Institute.)

$$AC_{\text{effec}} (\text{Mix Basis}) = \%AC - \left\{ \frac{\% \text{Absorbed AC by weight of aggregate} \times \% \text{Aggregate in mix}}{100} \right\}$$

Perform calculations to the nearest hundredth and round to the nearest tenth.

³The mix design will be approved if the laboratory mix meets one of the three properties, % VMA, Fines/Asphalt Ratio, or Film Thickness.

The target value for each sieve for the mix design shall be the average of production samples multiplied by the percentage of material used in the blend propor-

tion. NDDOT will blend the aggregate at the blend proportions specified by the contractor. The blended sample will be used for the mix design if the gradations obtained from the blended sample are within the tolerances listed in Table A when compared to the target values determined previously. If the aggregate is not within tolerance a mix design will not be developed. Mix production will not begin until a mix design is developed.

**TABLE A
ACCEPTABLE TOLERANCES**

5/8" – #4 sieve	± 5%
#30 sieve	± 3%
#200 sieve	± 1.5%
Plastic Index	± 2%

The result of the mix design process is the Job Mix Formula (JMF), and will contain the following:

1. The percentage of aggregate passing each of the specified sieves.
2. The percent asphalt cement to be added to the mixture.
3. The target air voids will be 4%.
4. The maximum specific gravity of the mixture obtained in the laboratory.
5. The bulk specific gravity of the mixture obtained in the laboratory.
6. The percent VMA of the mixture obtained in the laboratory.
7. The stability of the mix.
8. The fines/asphalt ratio.
9. The asphalt film thickness.

The target value for each sieve may be adjusted during production if the Engineer and the Contractor agree that a change is necessary to maintain the air voids between 3 and 5%. Any change to the JMF will be checked immediately using the procedures required in Section 408.05 C.

The Contractor shall provide eight one-quart containers of bitumen of the type and grade specified in the Plans with the aggregate samples submitted. The type, grade, and name of the supplier of the bitumen shall be submitted in writing with the sample. The bitumen shall meet all requirements of Section 818 and shall be from the supplier the Contractor uses for the project.

If aggregate or asphalt is utilized from sources other than those initially submitted, if the aggregate is processed using a different crusher, or if a different type or grade of asphalt is used, the Contractor shall notify the Engineer in writing five days before incorporating the material into the work. If the Engineer determines that a new mix design is required, the Contractor shall provide a sample of the material to the Engineer and allow the Department three working days to prepare or approve a new mix design. If the Contractor fails to provide a timely sample, the

Contractor shall cease operations and allow the Department three working days to prepare or approve a new mix design.

- C. **Heating of Bitumen.** The bitumen shall not be overheated and shall be continuously supplied to the mixer or drum dryer at a uniform temperature.
- D. **Preparation of Aggregate.** For batch or continuous mix plants, the aggregates shall be heated and dried to reduce the total moisture content to 1/2 of 1% or less based on the dry weight of the aggregate.

When the drum-dryer mixer is used, the moisture content of the bituminous mixture shall not exceed 1%.

Aggregates prepared for use with a cold-feed control shall be screened into 2 or more fractions. The aggregate shall be fed from the stockpile into separate compartments for accurate proportioning into the mixer.

- E. **Mixing.** All materials shall be introduced uniformly into the pug mill or the drum dryer, in the proportions necessary to produce the required quality. Bitumen shall be proportioned within ± 0.24 percentage points of the percentage of bitumen designated by the Engineer.

The required quantities of aggregate and bitumen shall be introduced into the mixer and the materials mixed until a uniform and complete coating of the aggregate is obtained.

- F. **Mix Temperature.** The temperature of the bituminous mixture at discharge from the mixer shall not exceed 300°F. The temperature of the mix at laydown shall be a minimum of 230°F. when the ambient temperature is above 60°F., and 250°F. when the ambient temperature is below 60°F.

If the density and temperature requirements of Section 408.04.I are not being met, the actual mixing temperature shall be adjusted so the specified requirements are satisfied.

- G. **Conditioning Existing Surface.** When it becomes impractical to correct local irregularities on an existing surface with a single lift leveling course or the pavement course and milling was not specified, the surface shall be brought to uniform cross section with additional bituminous mix. The mixture shall be thoroughly tamped or rolled and shall be the same mixture as specified for the next course. Where the existing surface is broken or unstable, the material shall be removed, disposed of, and replaced with the same mixture specified for the next course.

Spot leveling courses shall be blade laid in lifts not to exceed 3 inches in depth.

Patching operations include removal of existing surfacing, base, and subgrade material to the depth required to obtain a stable subgrade. If required, a class of aggregate satisfactory to the Engineer shall be placed and compacted to the bottom of existing bituminous pavement to a minimum depth of 3 inches below the existing surface. The hot bituminous material shall be placed with a motor grader in lifts not to exceed 3 inches, compacted with rubber-tired equipment and cured for 48 hours before being overlaid, except in such instances where the breakup occurs during the actual paving operation. If the breakup occurs during the paving operation, a 48-hour curing period will not be required.

After removing loose dirt and other objectionable material from the surface, a tack coat shall be applied to the surface and to the exposed edges of longitudinal and transverse joints before placing a leveling or surface course.

- H. **Spreading and Finishing.** All mixtures shall be spread and finished with bituminous pavers to the required section leaving the mixture uniformly dense, smooth, and free from irregularities. In locations where it is impractical to use normal lay-down equipment, other methods may be used when approved by the Engineer.

Loads of mix and sections of pavement containing uncoated batches of aggregate, segregated materials, aggregate which is obviously outside gradation Specifications, or too much bitumen will be rejected. Loads showing these characteristics shall not be used in the work. If these conditions are evident after finishing operations, the defective sections will be rejected and removed at the Contractor's expense. If the quality of the mix on the road is in question, the Engineer may test samples taken from the in-place work prior to final acceptance.

The speed of the bituminous paver shall be controlled to lay the mixture uniformly and continuously without tearing or gouging. The paver's speed shall not exceed the manufacturer's recommendation and shall be coordinated with the output of the plant to provide for a smooth, continuous operation with the paver.

All transverse and longitudinal joints, high or low areas, and surface irregularities shall be leveled, filled, or raked before compaction. Loose material shall be removed from previously compacted lanes or joints before compacting adjacent lanes.

Paving operations shall be conducted to minimize the inconvenience to traffic and protect existing and finished surfaces. Placing bituminous mixture shall progress so a single lane is not more than one day's run in advance of any adjacent lane. Altering the sequence of paving operations to best suit construction conditions may be required. The Contractor shall not permit two-way public traffic past the machine laydown operation without the use of a pilot car. A pilot car to control one-way traffic shall be furnished by the Contractor.

A tack coat shall be applied on a previously placed layer or surface before spreading the next layer.

Hot bituminous pavement shall not be placed on bridge decks unless specified.

When required, the Contractor shall excavate locations where the new surfacing meets existing pavement, bridge ends, or railroad crossings to allow full depth placement of the surfacing course. If excavation is required, it will be paid according to Section 104.03 D.

Rumble strips shall be milled into asphalt shoulders and be placed in a continuous pattern. Rumble strips will be discontinued across the full width of all public and private (residential and commercial) road approaches, entrance and exit ramps, and within designated city or urban limits. Rumble strips will not be installed on shoulders less than 4 feet in width.

I. **Compaction.**

1. **General.** Except for shoulders, driveways, section line approaches, leveling courses and patching, the bituminous mixture shall be compacted according to Section 408.04 I.3, Specified Density.

The sequence of rolling operations and the selection of type and number of rollers shall be commensurate with production and shall be adequate to attain the specified density before the mat temperatures falls below 185°F. The compaction equipment for mainline paving shall include not less than one steel or vibratory roller and one pneumatic-tired roller conforming to Sections 151.02 B, C.2, C.3, C.4, or D. A combination roller meeting the requirements of Section 151.02 E may be used in lieu of the pneumatic-tired and vibratory roller.

Rolling shall begin at the edges and proceed parallel to the road centerline with each trip overlapping the previous roller pass, and progressing to the crown of the road. When paving in echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. On super-elevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline. Displacement resulting from reversing the direction of a roller, or from other causes, shall be corrected immediately with rakes and the addition of fresh mix. Care shall be exercised in rolling edges of the bituminous mixture so line and grade of the edge is maintained.

In areas not accessible to rollers such as along forms, curbs, headers, and walls, the mixture shall be thoroughly compacted with hand or mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, shows any excess or deficiency of bitumen, or is defective in any manner, shall be removed and replaced with fresh hot mixture, and compacted to the density of the surrounding area.

2. **Ordinary Compaction.** Ordinary Compaction shall be used on shoulders, driveways, section line approaches, bike paths, leveling courses and patching projects.

The testing, Contractor coring and compaction payment schedule specified in Section 408.05 C will not apply for leveling courses, patching, and bike paths.

When specified density on mainline is required, the laboratory testing requirements in Section 408.05 C.1 will apply for shoulders, driveways, and section line approaches. The contractor coring and compaction payment schedule in Section 408.05 C.2 and 408.05 C.3 will not apply.

Compaction consists of initial or breakdown rolling, intermediate rolling, and final or finish rolling.

Breakdown rolling shall consist of one or more complete coverages with a roller meeting the requirements of Sections 151.02 B, 151.02 C.2, or 151.02 D.

Breakdown rolling shall be followed by intermediate rolling with a roller conforming to Section 151.02 B until the surface is tightly bound and shows no displacement under the roller. Intermediate rolling shall be completed before the mat temperature falls below 185°F. The Engineer has the option to remove the pneumatic-tired roller if compaction can be achieved without, and there is a problem with the tires picking up or with roller marks in the mat.

The final rolling shall be performed with a roller conforming to Section 151.02 C.3 or 151.02 D in the static mode, and shall continue until roller marks are eliminated.

The Contractor may be required to modify the rolling sequence to best suit construction conditions.

When compacting leveling courses and patches spread with motor graders the initial rolling shall be by pneumatic-tired rollers done simultaneously with the spreading. Additional pneumatic-tired rollers required for obtaining compaction shall conform to Section 151.02 B. The roller specified for final rolling may be omitted with approval of the Engineer. The desired degree of compaction will be considered obtained when the surface is tightly bound and shows no displacement under operation of the roller.

3. **Specified Density.** This method provides for compacting bituminous mixture on interstate crossroads, ramps, rest area approaches, parking lots, and mainline pavement according to the density requirements specified in Section 408.05 C.

Bituminous mixture placed on shoulders, driveways, and section line approaches are exempt from the specified density requirements. Such mixtures shall be compacted to the satisfaction of the Engineer with the same rollers and rolling sequences used on the mainline. In confined areas, other rollers may be used, as approved by the Engineer.

- J. **Joints.** Joints shall be tacked and constructed with adequate bond on abutting surfaces. Vertical construction joints in successive courses shall be placed so the joints do not fall in the same vertical plane.

Pavement placed against the surface of curbing, gutters, manholes, and similar structures shall be placed uniformly high near the contact surfaces so the pavement is slightly higher than the edge of the structure after compaction.

- K. **Maintaining Completed Course.** Upon completion of the final rolling and finishing, surface maintenance required due to construction operations shall be at the Contractor's expense until the next or final surface is placed or until the work has been accepted by the Department. Maintenance shall include the removing, replacing, reshaping, and recompacting of damaged areas.

- L. **Tolerances.** The surface shall be smooth, uniform, and true to Plan crown, alignment, and grade. Surfacing thicknesses shown on the typical sections are minimum and the estimated plan tonnages shall be used uniformly throughout the Project.

Any low or high defective areas shall be corrected as directed by the Engineer. Corrective work shall include patching or cutting out the surface and replacing with fresh hot bituminous mixture, or by milling the surface. The surface of the finished pavement shall be free from irregularities exceeding 3/16 inch as measured with a 16-foot straightedge parallel and perpendicular to the centerline of the roadway.

Deficiencies in smoothness, improperly constructed joints, and surface irregularities shall be corrected with a second diagonal rolling crossing the line of the first at the Contractor's expense.

M. Limitations.

1. **Weather.** Hot bituminous mix shall not be placed on a damp surface, on a frozen roadbed, or when weather conditions prevent the proper handling or finishing of the bituminous mixtures. Presence of frost particles in the roadbed is sufficient evidence of being frozen. Hot bituminous mix shall not be placed when the air or mat surface temperatures are below the following minimums:

AIR TEMPERATURE

Compacted Thickness	Air Temperature Surface Course	Subsurface Course and Approaches	Existing Mat Temperature*
1-1/2" or less	45°F.	40°F.	40°F.
More than 1-1/2"	40°F.	35°F.	40°F.

*Existing mat temperature will be measured with an infrared sensing thermometer or by a conventional thermometer inserted into a one-inch deep hole in the pavement and filled with water, oil, or grease.

2. **Operational.** Traffic shall not be permitted on the completed surfacing until the lift has been compacted and has cooled sufficiently to prevent damage.
- N. **Bituminous Pavement Sloughs.** Bituminous pavement sloughs shall be compacted with rollers capable of providing a smooth finished compacted slough that is free of tire marks and unevenness or drop-off. Density tests are not required.

408.05 ACCEPTANCE.

The aggregate gradation pay factor in Section 408.05 A.1. and the bitumen uniformity requirements in Section 408.05 B.2 will not apply when the total plan quantity of hot bituminous pavement is 4,000 ton or less. When the total plan quantity of hot bituminous pavement is 4,000 ton or less the material will be accepted according to Section 105.07.

A. Aggregate.

1. **Gradation.** Aggregate will be sampled and tested in lot sizes equal to the number of tons placed each production day. One aggregate sample will be tested for each 1,500 ton of mix produced with a minimum of one sample per day. Payment for the mix represented by the samples will be based on the deviation from the job mix formula.

The Contractor shall obtain all aggregate samples at random times determined by and under the observation of the Engineer. The samples shall be taken from the cold feed belt according to AASHTO T-2, Section 4.3.1 or 4.3.2. The sample shall be split into two representative samples, numbered and bagged by the Contractor under the observation of the Engineer. Both halves of the sample shall be submitted to the Engineer. The untested half of the sample will be retained by the Engineer for 24 hours after the test results are made known to the Contractor. Either party may request that the second half of the sample be tested within this 24 hour time frame. The test results from this re-test shall replace the test values of the initial test.

If any two consecutive tests vary from the JMF gradation target value set for each sieve by more than the tolerances listed below, the pay factor for the full days production will be the lowest pay factor determined from the following formula, unless the daily air voids of the marshall plugs as determined in Section 408.05 C.1 are between 3 and 5% and the aggregate gradation for each sieve is not outside the gradation band for the class of aggregate specified, then the pay factor will be 100%.

$$\text{Pay Factor} = \frac{100 - \text{Deviation from the Target Range}^*}{100}$$

*Target Range = target value + or – the acceptable tolerance value listed below:

AGGREGATE TOLERANCES

5/8 sieve ¹	–2%
1/2" – #8 sieve ²	± 7%
#16 – #50 sieve ²	± 6%
#200 sieve ²	± 2%

¹A tolerance of 2% in the amount passing the 5/8" sieve will be permitted providing all material passes the 3/4" sieve.

²The target value + or – the tolerance allowed shall not exceed the specified gradation range.

If the material fails to meet the specifications for two consecutive lots, the Contractor shall not incorporate any additional material into the work until the Engineer is satisfied that the Contractor is taking necessary corrective action to meet the Specifications. The Engineer may request that a new mix design be developed if the Contractor is unable to meet the Specifications.

2. **Additional Aggregate Tests.** Aggregate samples to determine shale content, plasticity index, fractured faces, and L. A. Abrasion loss will be taken by the Contractor, under the observation of the Engineer, before the addition of bitumen to the mix.

The shale content and plasticity index of the aggregate will be determined by the average of test results from 3 random samples taken from the cold feed belt from each lot of 10,000 tons or fraction thereof. The samples will be tested and the material will be accepted if the average of the 3 samples meets the specified requirements. If each of the samples is within the specified limits, only one of the 3 samples will be tested from each subsequent lot. If at any time the sample tested does not meet the specified requirements, the remaining 2 samples will be tested. The average of these 3 samples will then be used to determine acceptance of the material. The testing of 3 samples per lot will continue until all 3 samples are within the specified limits, then only one of the 3 samples will be tested from each subsequent lot. If the average exceeds the specified maximum for shale content, the unit price for the bituminous mixture will be adjusted according to Section 408.07 B. If the average fails to meet the specified requirements for plasticity, the material will be rejected, unless the Construction Engineer elects to accept it under Section 105.07.

The L. A. Abrasion loss percentage of aggregate will be determined on the basis of one composite aggregate sample taken and tested during the begin-

ning of the aggregate stockpiling. If this percentage exceeds the maximum allowable loss, the material will not be accepted.

The percentage of fractured faces for course aggregates will be determined by the average of test results from 3 random samples taken from the cold feed belt for each lot of 10,000 tons of bituminous mixture produced. The samples will be tested and the material will be accepted if the average of the three samples meets the specified requirements. If each of the samples is within the specified limits, only one of the three samples will be tested from each subsequent lot. If at any time the sample tested does not meet the specified requirements, the remaining two samples will be tested. The average of these three samples will then be used to determine acceptance of the material. The testing of three samples per lot will continue until all three samples are within the specified limits, then only one of the three samples will be tested from each subsequent lot. If the average fails to meet the specified requirements, the material will be rejected unless the Construction Engineer elects to accept it under Section 105.07.

- B. Bitumen Content.** The required bitumen content, or target percentage, will be designated by the Engineer.

The quantity of bitumen used and paid for from each lot will be determined by the use of daily oil cutoffs following the procedures outlined on the Mix Bitumen Cutoff Report. A lot shall be defined as the amount of bitumen used each production day.

The pay factor for the hot bituminous pavement, adjusted for bitumen content, will be the lowest pay factor determined by both of the following methods:

1. **Average.** If the daily cutoff, as determined on the Mix Bitumen Cutoff Report, deviates from the target percentage set by the Engineer by more than 0.24 percentage points the pay factor will be determined from the following table:

BITUMEN CONTENT

Pay Factor	Deviation from Target in Percentage Points
1.00	.00–.24
.98	.25–.29
.95	.30–.34
.92	.35–.39
*	.40 & Over

*The Construction Engineer will determine the pay factor according to Section 105.07.

2. **Uniformity.** The Engineer will check the asphalt content each time an aggregate sample is taken. The checks will be based on readings from the totalizers for the aggregate and the bitumen as outlined in the Asphalt Content Determination Report. If the asphalt content from any random reading varies from the daily average of the readings by more than 0.24 percentage points, the pay factor for the hot bituminous material will be adjusted according to the following formula:

$$\text{Pay Factor} = \frac{100 - [20 (* \text{Deviation} - 0.24)]}{100}$$

*Deviation from the average daily asphalt content.

C. Compaction.

1. **Testing.** The compaction of the mixture will be accepted in lot sizes equal to the number of tons placed each production day. The density of the pavement will be determined from cores obtained by the Contractor, as specified in Section 408.05 C.2.

Each subplot will be one paver width wide, excluding the shoulders, 2,000 feet long, and of the depth specified for the pavement course. If the partial subplot remaining at the end of a production day is 1,000 feet in length or longer, it will be considered a separate subplot. If it is less than 1,000 feet long, it will be included in the last complete subplot. If the total day's production is less than 2,000 feet long (one paver width wide), that production will be considered a lot.

The mean density of the mainline pavement placed each production day will be the average of the densities of all of that day's sublots. In addition to testing randomly selected locations, the Engineer reserves the right to direct the testing of any areas which appear defective. Defective areas will be rejected unless the Engineer elects to accept it under Section 105.07.

The Contractor, under the observation of the Engineer, shall:

- a. Obtain mix samples from behind the paver at random times specified by the Engineer. One sample shall be taken each time an aggregate sample is taken; and
- b. Compact three marshall specimens with each sample taken to determine the field marshall density. The number of blows applied to the marshall specimens shall be 50, unless otherwise specified, and the temperature of the mix shall be 270 plus or minus 5°F; and
- c. Determine the Maximum Theoretical Density of each sample taken.

The methods used to obtain the samples, compact the marshall specimens and determine the Maximum Theoretical Density shall be as outlined in the Department's *Field Sampling and Testing Manual*.

For a project on an NHS route, the Engineer will do acceptance testing according to Appendix G of the Department's *Field Sampling and Testing Manual*.

2. **Contractor Coring.** The Contractor shall take two cores in each subplot at a random location determined by the Engineer and under the observation of the Engineer. After coring and sawing, the cores shall be handed over to the Engineer. The cores shall be taken adjacent to each other and the average of the two cores shall be used for determining the density of the subplot.

The Contractor shall take two additional full-depth cores per mile, under the observation of the Engineer, with one location in each lane, for the District

Materials Coordinator to use as an independent assurance test. The District Materials Coordinator will determine the locations of these cores. The cores shall not be sawed by the Contractor.

The coring machine shall cut a cylindrical sample in the compacted asphalt lift without disturbing the density of the sample. The core samples shall be 4 to 6 inches in diameter. The masonry saw shall cut the core sample so only the compacted layer to be tested is removed; and the core is in a condition suitable for testing.

Coring of each day's paving shall be completed no later than the next working day following the placement of the lift. Cores shall be taken through the full depth of the in-place asphalt pavement. The surface of the outside of the cores shall be smooth with no distortion of the cylindrical shape or displacement of the aggregate particles. A masonry saw shall be used to remove the compacted layer from the full-depth core without damaging the newly placed asphalt material.

The Contractor shall fill all holes remaining in the surface of the roadway with bituminous material and compact the material as directed by the Engineer. Each core shall be numbered or lettered to identify the location from which the core was taken. The marking system shall meet the approval of the Engineer.

The Contractor may elect to take a check sample, at the Contractor's expense, whenever the average density of a set of cores is 89% or less than the Theoretical Maximum Density. A check sample shall be a set of cores taken within 2 feet of the location of the failing set of cores. The average density of the check sample cores will be the result used to determine the Unit Price of the hot bituminous pavement.

Retests and additional tests will not be taken or paid for unless approved by, or directed by, the Engineer.

The Contractor shall control traffic according to the traffic control plan to ensure the safety of the coring crew and the traveling public. The Engineer may alter these requirements depending on the location of the coring operation in respect to the existing traffic control zone, and in situations where traffic is being controlled by a pilot car and/or flaggers. Coring operations shall not take place adjacent to the paver to avoid blocking traffic.

3. **Compaction Payment Schedule.**

- a. Acceptance of mainline pavement placed on any production day will be based on the average density of the pavement compared to the daily average maximum theoretical density (MTD) determined for each lot of pavement placed. The average density of the field cores shall be at least 91% of the daily average MTD. Each individual subplot shall have an average density of at least 89% of the daily average MTD. If the average density of the field cores is less than 91% of the daily average MTD or any subplot is less than 89% of the daily average MTD the Unit Price of the hot bituminous pavement will be adjusted according to the following tables:

**PAVEMENT DENSITY
ADJUSTMENT OF UNIT BID PRICE PER LOT**

Pay Factor A	Average Pavement Density
1.00	91% or greater
.99	90.0% – 90.9%
.975	89.0% – 89.9%
.95	88.0% – 88.9%
.925	87.0% – 87.9%
*	Less than 87.0%
 Pay Factor B	 Lowest Density of any Sublot
1.00	89% or greater
.99	88.0% – 88.9%
.98	87.0% – 87.9%
.97	86.0% – 86.9%
.96	85.0% – 85.9%
*	Less than 85.0%

*The Engineer will determine whether the material may remain in place. The Pay Factor for the material allowed to remain in place shall be .70 for Pay Factor A and .80 for Pay Factor B.

The density of the field cores will be determined according to the Department's Field Sampling and Testing Manual. The Total Pay Factor will be the product of the pay factor for the average pavement density and the lowest sublot.

$$\text{TOTAL PAY FACTOR} = (\text{PAY FACTOR A}) \times (\text{PAY FACTOR B})$$

408.06 METHOD OF MEASUREMENT.

The estimated quantities provided may be adjusted by the Engineer in the field. Any increase or decrease in the quantities used shall not be a basis for renegotiation in the price bid for these items.

- A. **Hot Bituminous Pavement.** Hot Bituminous Pavement will be measured by the Ton or Square Yard according to Section 109. Batch weights will not be permitted as a method of measurement unless the plant is equipped with an automatic batching and weighing system with an automatic printer system which prints the weights of each batch and issues a weigh ticket for each load. The Tonnage will be the weight used in the accepted pavement and no deduction will be made for the weight of bitumen used in the mixture.
- B. **Bitumen.** Bitumen will be measured according to Section 109 and the quantity of bitumen will be the number of Tons or Gallons used in the accepted work.
- C. **Cored Sample.** Each individual cored sample that is removed in the required condition will be measured as a unit. The work vehicle, coring machine, masonry saw, and the shadow vehicle will not be measured for payment, but will be included in the measurement of the cored sample.

408.07 BASIS OF PAYMENT.

Payment will be made at the Contract Unit Price for the following:

Pay Item	Pay Unit
Hot Bituminous Pavement	Ton
--- Asphalt Cement	Ton or Gallon
Cored Sample	Each

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.

When price adjustments are required for failing material or patching, payment will be made as follows:

- A. Determination of the payment adjustment of a lot of bituminous mixture will be made by successively multiplying the Contract Unit Price per Ton of the bid item by the applicable pay factors as determined in Sections 408.05 A, 408.05 B, and 408.05 C.
- B. When the average of the test results specified in Section 408.05 A.2 shows a larger shale content than the maximum allowable specified, the following deduction from the Bid Price for the bituminous mixture item will be made:

One percent reduction in unit price for each 0.2% above the maximum allowable percentage. If the percentage of shale exceeds the allowable limits by 2% or more, the material will be rejected unless the Construction Engineer elects to accept it under Section 105.07.

This reduction will apply to lots of 10,000 tons, and will be applied independently of Section 408.05 A.1.

- C. Material for patching or leveling of an existing bituminous surface constructed under a previous Contract shall be obtained from the tonnage provided in the basis of estimate and will be paid according to the following provisions:
 - 1. For all leveling and patching when no excavation is required, payment will be made at the Contract Unit Prices for the materials used in the repair.
 - 2. When the patching requires excavation, the method and site of disposal of the waste materials shall be subject to the approval of the Engineer, and:
 - a. If the excavated material is disposed of within the Right of Way adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-1."
 - b. If the excavated material is loaded and hauled to a disposal area not adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-1."
 - c. If aggregate is required to replace excavated material in the existing base or subgrade, payment for the class of aggregate used will be made under

Section 104.03 D. Payment will include disposal of excavated material, and the furnishing, placing, and compacting of the aggregate.

- d. Payment for prime, tack, and the bitumen in the mix used in the repair will be made at the Contract Unit Prices for those items.

SECTION 409 HOT BITUMINOUS PAVEMENT QUALITY CONTROL/QUALITY ASSURANCE

409.01 DESCRIPTION.

This work shall consist of constructing one or more courses of bituminous pavement on a prepared surface for Quality Control/Quality Assurance (QC/QA) projects. The Contractor shall be responsible for process control, and shall perform the necessary testing to control the quality of the work. When specified on the plans the contractor shall develop a mix design.

409.02 MATERIALS.

- A. **Bitumen.** The bitumen shall meet Section 818 and will be of the type and grade specified in the Contract. Bitumen will be accepted as outlined in the Combined State Binder Group agreement for North Dakota. Samples will be obtained by the Contractor under the observation of the Engineer, and immediately handed over to the Engineer for shipping and testing.
- B. **Aggregate.** The Aggregate Gradation Master Range for the class of aggregate specified shall conform to the following requirements:

Sieve Size	Percent Passing
5/8 in.*	100
1/2 in.	90 – 100
No. 4	45 – 80
No. 30	10 – 35
No. 200	2.0 – 7.0

*A tolerance of 2% in the amount passing the 5/8 inch sieve will be permitted providing all material passes the 3/4 inch sieve.

The gradation values listed are the extreme limits for design purposes. During Production mixture tolerance on all sieves, may fall outside the aggregate master range, except on the 200 sieve. The remaining physical properties, (lightweight pieces, P.I., fractured faces, etc.) for the class of aggregate specified, shall be as specified in Section 816.03 of the Standard Specifications.

409.03 EQUIPMENT.

Equipment shall be as specified in Section 408.03.